Staged corrective surgery for complex adolescent kyphoscoliosis caused by back scalding during the childhood period

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Abstract

Introduction Adolescent scar contracture kyphoscoliosis is a very rare disease.

Methods and Results Here, we present the case of a 21-year-old man who was scalded due to ebullient water

when he was 10 years old. Moreover, kyphoscoliosis was found when he was 12 years old and developed rapidly. Thereafter, no management was proposed before his consultation at our center. On examination, kyphoscoliosis was detected in thoracolumbar, the trunk deviated to the right on standing view, extensive contractured scar presented on the right side of the back, abdomen, chest wall, hip, right thighs and armpit anterior, especially in the right flank. A one-stage correction was deemed too risky, we therefore released contractured scar during the first stage with the defect of soft tissue protected by vacuum sealing drainage and then performed skeletal traction with halo and bilateral femoral pins. A reasonable correction was achieved without any neurological deficits 1 month after traction. Next, a second-stage operation was taken to translate a free anterolateral thigh myocutaneous flap to overlay the extensive defect of soft tissue. 1.5 months later, a third posterior segmental pedicle screw instrumented fusion with Smith-Peterson osteotomy between T9 and L2 was performed. Postoperative recovery was uneventful and as there were no complications, he was discharged 10 days after the third surgery. At 2-year follow-up the patient's outcome is excellent with balance and correction of the deformity.

Conclusion Based this grand round case and relevant literature, we discuss the different options for the treatment of adolescent scar contracture scoliosis.

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Case presentation

A 21-year-old man presented in our department on 10 December 2009 with physical handicap, unstable walking

Fig. 1 Before the operation, extensive contracted scar presented on the right side of the back, abdomen, chest wall, hip, right thighs and armpit anterior, especially in the right flank of the patients

and psychological upset with marked deterioration in deformity but without neurological deficit. On examination, his trunk deviated to the right on standing view and curvature of the thoracolumbar spine was left-sided (convex to the left side). He had multiple extensive contracted scars presented on the right side of the back, abdomen, chest wall, hip, right thighs and armpit anterior, especially in the right flank (Fig. 1) little muscle tissues were present under the contracted scars. The pelvis was oblique with the right side higher than the left side. The right arcus costarum was close to the right ilium. He had normal sensation, movement and reflexes in upper and lower limbs. X-ray analysis showed that there was a rigid right thoracolumbar kyphoscoliosis from T6 to L2, with an apex at T11. The coronal curve was 122° as measured by the Cobb's method, and kyphosis was 100° (Fig. 2a). In addition, his coronal balance was deviated on the right side, 9 cm from the C7 plumb line to the center sacral vertical line, but his sagittal balance was within normal limits. The flexibility of the coronal curve in side bending was 9.8 % (122° – 110°), and increased to 41.0 % (122° – 72°) after the Halo-femoral traction (Fig. 2b). Preoperative CT and MRI analysis revealed no vertebral or intraspinal deformity. His parents agreed surgery treatment for him and an informed consent was taken following a three-stage procedure.

Fig. 2 **a** Initial AP and lateral standing X-rays of the patient. The left thoracolumbar curve was 122° with an apex at T11, and kyphosis was 100° , and **b** 1.5 months after Halo-bilateral femoral traction, the AP X-rays showed that coronal major curve was 72°

Diagnostic imaging section

Diagnosis and incidence

Adolescent scar contracture kyphoscoliosis is a very rare deformity, when the patient has contracted lateral truncal soft tissues, which may include the skin only, may be with thoracolumbar fascia, intertransverse process ligament, muscles of abdominal wall and paraspinal muscles, because injury of the paraspinal soft tissue beside the spine could result in a mechanical imbalance and lead to scoliosis [1–3]. The new nomenclature proposed by Qiu [4] was introduced to avoid the confusion between idiopathic scoliosis, congenital scoliosis and many other types of scoliosis, such as Duchenne muscular dystrophy, thoracotomy, multicore myopathy with paraspinal contractures, contractures and growth disturbances in the hip and pelvis, especially radiation to the juxtaspinal and fractures to the bony spinal column along with continued exposure to physiological stresses.

The diagnosis is simple for patients with a history of extensive full thickness scalding on the lateral trunk in the infantile or childhood and subsequent progressed scoliosis or kyphoscoliosis. Due to the traction of the contracted scar tissues, the spine is convex to the side without the contracted scar or with less scar tissue. The X-ray, CT and MRI show that there is no congenital vertebral and intraspinal deformity. In addition, no clinical manifestation of syndrome scoliosis is presented.

The incidence of adolescent scar contracture scoliosis is difficult to know because this condition seldom occurs. Its incidence was reported to be 0.31 % because there were

only four cases of adolescent scar contracture scoliosis in 1,300 patients operated [4]. The pathogenesis of scar contracture scoliosis correlates more closely with the so-called postradiation spinal deformity [1] after radiation to the juxtaspinal and pleural scoliosis following extensive pleural scarring [3] due to chronic or acute infection. Extensive and full thickness skin scalding at the lateral surface of the trunk during the infantile and childhood period can lead to contracture of these soft tissues and leave a large area of scar tissue, which can compromise the balance of the spine and limit the movements of the spine, leading to scoliosis with lordosis or kyphoscoliosis. The curve types are single thoracic or long thoracolumbar curve, scar contracture in the back may induce lordosis, scar contracture in the abdominal may induce kyphosis, and scar contracture in the lateral may induce scoliosis. Pelvic obliquity may be found in the patient for the traction of the contracted scar tissues, the iliac crest on the concave side of the scoliosis is higher than that on the convex side, similar to scoliosis caused by leg-length discrepancy. The trunks shifted toward the concave side of the curve. These deformities give an imbalanced growth and should be detected early in life so that an appropriate surgical treatment can rebalance the growth of the spine. If left untreated, some of these cases would end up as major rigid spinal deformities later in life as in our patient. To correct these large deformities, extensive contracted scars should be cut and released at first, and then either a lengthening procedure or a shortening procedure should be performed. Adolescent scar contracture kyphoscoliosis can be diagnosed by physical examination; after being scalded the patient may present with a subsequent curved truncal deformity, scar contracted manifestations or as an incidental finding on X-rays. Clinical examination in these patients should be comprehensive to eliminate some syndromes of scoliosis.

Rationale for treatment and evidence-based literature

The treatment of adolescent scar contracture scoliosis is complex because we must consider both the extensive contracted scar and the rigid spinal deformity. The literature on the surgical management of these complex deformities is scarce.

Treatment modalities include either observation or surgery. Observation is used for curves with little growth potential and Cobb angle not more than 20°–30°, and when the extent of contracted scar is not extensive. Braces have a very limited role, and are only used in long flexible curves, secondary curves and as an adjunct to surgery to assist fusion [5]. Surgery is either prophylactic or corrective. Prophylactic surgery is indicated for younger children

who have small and progressive curves: to release the extensively contracted scar, followed by skin grafting, a free flap translating, or Z-plasty to interrupt the procedure of scar contracture. Recently, Grishkevichsu reported 12 patients with lateral truncal contractures were operated using trapeze-flap plasty and good, immediate or late results have been achieved, suggesting that trapeze-flap plasty is the most effective technique [6].

The contracted scar tissues should be sufficiently released before the correction of the deformity, and the defect of soft tissue should be overlaid without a potentiality of new contracture. The real flexibility of the spinal deformity is unknown preoperatively because of the contracted scar. Halo-gravity traction is a safe, well-tolerated method of applying gradual and sustained traction to maximize postoperative correction in severe and rigid scoliosis [7, 8]. Halo-bilateral-femoral traction provides significant corrective forces [9]. The procedures of the corrective surgery can be done either by a single-stage posterior approach and skin grafting, a free flap translating, Z-plasty, or a multistage approach. Rapid correction of severe scoliosis may increase the risk of neurological compromise, especially if there is a significant kyphotic component. Posterior in situ fusion has potential risk for crankshaft phenomenon in younger children while the definitive posterior instrumented fusion with Smith-Petersen osteotomy (SPO), pedicle subtraction osteotomy (PSO) or vertebral column resection (VCR) show progressively improved effects, although the risks of neurologic complications are progressively increased as well [10]. Spinal cord monitoring and wake-up test are mandatory for the treatment by either a single-stage posterior approach or a multistage approach, and osteotomy is ideally done in the lumbar spine below the spinal cord because it remains more challenging to perform osteotomy at the thoracic level. With initial skeletal traction gradually lengthening the spine over a short period of time and carefully monitoring the neurological status, definitive posterior instrumented fusion can produce better correction effects.

In this Grand Round case, a single-stage corrective procedure was supposed to be too risky. First, the contracted scar was rather extensive and its depth was unclear, if the scar tissue was released, we could not ensure the completeness of the chest wall and abdominal wall, and it would be a great challenge for surgeons to overlay the defect of soft tissue and get the surgery wounds healed if the chest wall and abdominal wall were defected. Second, the one-stage lengthening procedure has a higher risk of neurological complications because of potentially stretching which may add to the spinal cord quickly, it may induce neurological complication. Third, the spinal deformity was too severe and rigid making it difficult to get good corrective effect. Although VCR or PSO may increase the corrective

effect, the repeated procedures and bad blood supply to the scar tissue may impact the recovery of surgery wounds, and the reductus of the rest contracted scar on the back is difficult to provide a safe and sterile surrounding, based on the above consideration, we gave up vertebrectomy in the third procedure. We proposed that the most appropriate treatment is to do the surgery staged with skeletal traction between the three stages which can achieve satisfactory correction and monitor the patient while keeping his balance. The first stage posterior-lateral release has advantages such as providing increased flexibility of the spine and decreasing the incidence of neurological complications during the traction and the third stage corrective surgery.

Procedure

The first stage surgery was conducted on 15 December 2009. Under general anesthesia, the patient was placed in a left lateral position. Extensive contracted scar was cut and stripped of paraspinal muscles, interception of contracted thoracolumbar fascia, excision of capsules and ligaments around the costo-transverse joints, the inter-transverse and intercostals muscles. There was a 22×30 cm defect of abdominal wall and 3×4 cm defect of peritoneum which was repaired quickly, the large defect of abdominal wall was overlaid by skin grafting and the rest defect of abdominal wall (10×5 cm) was overlaid by vacuum sealing drainage (VSD). Then the halo ring and bilateral femoral pins were applied, the halo bilateral femoral traction increased from 5 kg to half of his weight 22 kg gradually. Correction of deformity was achieved by increasing the weights daily.

Patient was monitored and he did not develop any neurological deficits.

Second-stage surgery was performed on 11 January 2010, when the defect of soft tissue was 12×15 cm. The patient was placed in a supine position to make the left free anterolateral thigh myocutaneous flap 22×30 cm, and then the patient was placed in a left lateral position. The free anterolateral thigh myocutaneous flap was translated to the defect of soft tissue in the right flank. After the second-stage surgery, the skeletal traction was continued with a half of his weight. Patient recovered uneventfully and the flap healed well. After 1.5 months traction, there was a reasonable improvement both in coronal and sagittal plane, X-rays under traction revealed correction of deformity on the coronal curve and Cobb angle was decreased from 122° to 72° .

The third-stage surgery was performed on 30 January 2010. The patient was placed in a prone position on the operation table with the skeletal traction unremitted. A midline exposure was carried out and the posterior segmental pedicle screw instrumented level was from T3 to L4, all the articular surface of articulationes zygapophysiales between T3 and L4 were cut off and all pedicle screws were placed by a free handed technology. During the procedure, SPO was done between T9 and L2 bilateral, adequate mobilization was achieved at all these levels. Contoured rods were applied and the deformity was further corrected using a rod derotation maneuver (Polynice, titanium, fixed and multi-axial pedicle screw system KangHui, China). At this stage, a wake-up test was performed and the patient moved both the feet normally. Cancellous allograft was placed in the interspaces between articulationes zygapophysiales and in the decorticated vertebral plate bed. The wound was closed over suction drains.

Procedure imaging section

Outcome

One week after the operation, the standing X-rays revealed a marked correction of the deformity and a 60° coronal curve and a 25° kyphosis in the thoracolumbar remnant. Drains were removed on second postoperative day and patient was allowed out of bed. His wound was completely healed. The patient was advised to wear a Boston brace for 3 months. Patient was discharged from the hospital on the tenth postoperative day and was followed up at 3 months, 6 months and then yearly. After the operation, the patient had obvious posture and deformity correction even on simple inspection. On the latest follow-up at 2 years, he had solid fusion (Fig. 3a–c), and had no complaints and was fully satisfied with the procedure.

Fig. 3 **a** Standing AP and Lateral X-rays 2 years after surgery, the coronal curve was 60° , **b** kyphosis was 25° , and **c** two years after operation

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Conflict of interest None.

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